JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1991, 24, 107–117 NUMBER 1 (SPRING 1991)

A FUNCTIONAL ANALYSIS OF THE COMPREHENSIVE APPLICATION OF BEHAVIOR ANALYSIS TO SCHOOLING

JANE E. SELINSKE AND R. DOUGLAS GREER
COLUMBIA UNIVERSITY TEACHERS COLLEGE

AND

SEEMA LODHI
BERGEN COUNTY SPECIAL SERVICES

This study tested the effects of a comprehensive application of behavior analysis to schooling on the total trials taught, correct student trials, and objectives achieved in a small school. The package was implemented in a school for children with multiple disabilities and included a staff training program based on a personalized system of instruction, organizational behavior management procedures for supervisors, regular assessment of teacher behaviors, and teacher assessment of all instructional trials received by the 38 children to a scripted curriculum. The design was a multiple baseline across four groups of teachers and included baseline, training, and full treatment phases over a 2-year period. The results showed educationally significant increases in trials taught, correct trials, and student objectives achieved as a function of the introduction of the package. A 3rd year of follow-up data and an analysis of the turnover of staff showed that the effects of the package were maintained and that the package had social validity.

DESCRIPTORS: education, school supervision, multiply handicapped students, teaching, effective instruction

Some have suggested that the very survival of our species depends on how well we educate (Skinner, 1984). Despite the need for effective educational practice, the evidence (Stallings, 1980) indicates that effective practices are not widespread. However, there are numerous effective practices in the literature of applied behavior analysis (e.g., Greer, 1983; Sulzer-Azaroff & Mayer, 1986). Several educational models have been developed and found to be effective, including direct instruction (Engelmann & Carnine, 1982), precision teaching (Lindsley, 1990), the personalized system of instruction (PSI) (Keller, 1968; Robin, 1976), programmed instruction (Skinner, 1968, 1984), and the consulting behavior analyst model (Greer, 1989; Sulzer-Azaroff et al., 1988). There have also been curriculum-wide applications to reading and math (Engelmann & Carnine, 1982), languages, science, and music (Greer, 1980), as well as procedures for teaching almost any subject matter in college (Robin, 1976; Sherman, Ruskin, & Semb, 1982). Yet, the improvements afforded by new pedagogical practices and curricular applications are not being adopted on a large scale by American school systems.

One critic (Brophy, 1983) has stated that the reason the research in behavior analysis is not widely adopted is that the research deals only with isolated problems in schools. More recently, a comprehensive model for applying the technology of behavior analysis has evolved (Greer, in press). The model, termed CABAS (comprehensive application of behavior analysis to schooling), applies behavior analysis to all school roles (students, teachers, and supervisors) and incorporates features of direct instruction, PSI, and programmed instruction and findings from the applied behavior analysis literature (Sulzer-Azaroff et al., 1988). In addition, CA-

This research was a doctoral dissertation by the first author, sponsored by the second author and assisted by the third author. We extend our appreciation to Nyla Lamm for assisting in the data collection and implementation of the treatment package.

Reprint requests should be addressed to R. Douglas Greer, Teachers College, Columbia University, New York, New York 10027.

BAS includes an organizational behavior management approach to the supervision and administration of schooling (Reid & Shoemaker, 1984).

Greer, McCorkle, and Williams (1989) performed a correlational analysis of the application of CABAS throughout a fiscal year and found high and statistically significant correlations between number of instructional trials received by students and attainment of learning objectives; number of weekly teacher observations and number of learning objectives achieved by students in the observed teachers' classes; teacher performance rates on weekly observations and number of learning objectives attained by all children in the teachers' classes (The term "teacher performance rate" refers to counts of the teacher's responses to student responses. It consists of the teacher's contingent reinforcement and error correction responses to student responses, or lack thereof, minus the errors in reinforcement or omissions of reinforcement or correction divided by duration in min. These counts of teacher behavior may be done with one-to-one instruction or with instruction to an entire class. The count incorporates presentation of instructional antecedents, response opportunities, and teacher consequences to student behavior.); and the number and rate (per hour) of target supervisor tasks completed with the number of learning objectives attained by all students in the school. Through a series of experiments, Ingham and Greer (1990) found that the use of the teacher performance rate/accuracy observation procedure (a component of CABAS) by a supervisor resulted in significant increases in total trials taught and correct responses of students in the observed and generalized settings.

The components of CABAS found to be associated with student behavior change were similar to the correlations between levels of student variables found in the literature on effective schooling (Stallings, 1980) and school supervision (Cotton & Savard, 1980; Edmonds, 1979). The emphasis on high rates of instruction requiring student responses (trials) is consistent with the opportunity-to-respond findings reported by Greenwood, Delquadri, and Hall (1984) as well as those reported in the task-engaged literature (Stallings, 1980). The CABAS model also draws on the literature of a variety of practices found to be effective in training and monitoring staff in other types of institutions (Ayllon & Michael, 1959; Iwata, Bailey, Brown, Foshee, & Alpern, 1976).

Despite the extensive research base for many of the components of CABAS and the descriptive analyses of the program (Greer, in press), there has been no experimental analysis of an application of CABAS to an entire school. This 2-year study permitted a test of the functional relationship between CABAS and the performance of teachers and students.

METHOD

Setting and Participants

Setting. The school in which the study was conducted was a private day school with a part-time residential program for 12 of the 38 students (Monday through Thursday evenings). The school was located in an urban metropolitan area and served blind students with multiple handicaps, some of whom were also deaf. The children ranged in age from 3 to 21 years.

Students. All students had some form of visual impairment, retardation, and at least one additional disability. Their communication skills (gestural or vocal) varied from some communication skills to none. Maladaptive behaviors, including self-injurious behavior, stereotypy, noncompliance, and assaultive behavior, were emitted by several students. (A complete description of the characteristics of the children may be obtained from the second author.) Although students were grouped by classes (home rooms), the classes were rotated across teachers during the course of the school day.

Teachers. Eight state-certified teachers participated. Teachers 1, 4, 5, 7, and 8 were classroom teachers. Teacher 2 was the instructor for daily living skills, and Teacher 3 was the instructor of prevocational skills. Teacher 6 was the speech teacher. The mean number of years experience for the teachers was 4.5. The staff in the teacher positions remained constant throughout the study. Two

teachers held master's degrees, 3 were enrolled in a master's degree program, and the remaining teachers held bachelor's degree. Each classroom had 2 teaching assistants trained in classroom applications of behavior analysis at the same time as the regular teachers. The 8 teachers and their assistants were assigned to four groups for purposes of the experiment.

Supervisors. A full-time educational director, a full-time teacher supervisor, and an assistant supervisor who worked 1 day per week were involved in supervisory activities in the school. Two supervisors held doctorates, and 1 was completing a doctorate in behavior analysis and special education; all had been trained in the supervision of CABAS as part of their doctoral training.

Consultant. The consultant (the second author) was a professor of education and psychology in a graduate school at a large university. He had designed CABAS and was still consulting on its implementation in two schools that had implemented CABAS previously (see Greer et al., 1989). The consultant met monthly with the supervisors and reviewed the weekly program summary data.

Treatment Package: Comprehensive Application of Behavior Analysis to Schooling (CABAS)

The CABAS treatment package consisted of the application of behavior analysis to performance of the students, teachers, and supervisors. The application with students involved data collection for all instructional trials. The instruction was standardized via scripted curricula specifying antecedent stimuli, responses, and consequences for all instruction. The application with teachers involved use of behavior analysis procedures as the basic pedagogical tools to assess and train students to meet individual education plan goals. Teachers were taught to use the skills and terminology of behavior analysis through continuous on-the-job training by supervisors and through out-of-class instruction with principles drawn from PSI (Keller, 1968). The supervisors trained teachers and assessed their productivity.

Application to students. The behavioral repertoires of each student were assessed initially through systematic direct observation. After deficits were identified, target objectives were determined in each curricular domain (cognitive, communication, self-help, school survival, physical development, and emotional/affective domains). For each child, scripted curricular programs were located in the existing curricula or were based on a scripted format designed to meet the individual objectives of each child.

The scripted curricula for students included long-term and short-term objectives, shaping instructions for the teachers, antecedent teacher behavior, definitions of correct responses, teacher instructions for responding to correct responses and incorrect responses, a standard least-to-most-intrusive prompt procedure with criteria for correct responses by prompt levels, the number of trials per program (usually 20), and the number of task analysis steps with related data collection forms.

The students were taught using continuous assessment of each student's responses (or lack thereof) by the teachers and teacher assistants. Whenever a child achieved criterion for an objective (typically three or more sessions at criterion level performance), the child was moved to a new short-term or long-term objective and the attainment of the objective was summarized and retained on the inventories described previously. All of the correct and incorrect responses of each child for each program (10 to 20 programs per child) were graphed and displayed prominently and daily in the classroom for parents, teachers, and supervisors to review. Each trial involved a teacher antecedent, a student response, and a consequence. Individual reinforcers were identified by baseline and treatment evaluations for each child.

An example of one trial from a single program follows. The student was presented with a three-dimensional object (e.g., a cube), the student felt the object, and the teacher said "What shape?" The student had a 5-s (for example) period to produce the correct signed or vocal response. An incorrect response resulted in a correction procedure (i.e., "This is a cube."). A correct response resulted in praise and the presentation of an edible reinforcer,

a token, or a brief activity period with a toy. The teacher recorded a minus for the lack of response or an incorrect response or a plus for a correct response, and then proceeded to the next trial.

The long-term objective of the above program might be the identification of four basic shapes for three consecutive sessions with 90% accuracy. The short-term objective might be the identification of two objects at the same criterion. Either the achievement of short-term or long-term objectives was recorded as the achievement of a single objective. In a program devoted to a self-help activity, such as walking from one classroom to another, the short-term objective involved completing the journey with partial prompts or no prompts for all task analysis steps for three successive sessions; the long-term objective involved performing without assistance. Each prompt level specified at least three successive sessions at 90% criterion.

Application to teachers and teacher assistants. Teachers were taught, through in-classroom instruction by the supervisors, to present scripted curricula systematically, to reinforce appropriately, to record student responses reliably, and to graph the session results immediately. Teacher assistants also were taught by supervisors and teachers to run selected scripted curricular programs and maintain group task engagement.

Each teacher was also assigned 10 modules or units of study with each module devoted to verbal behavior about a component of behavior analysis (e.g., readings on data collection, reinforcement) and applications in the classroom (e.g., collecting and graphing reliable data). The modules contained quiz objectives for the readings as well as on-the-job performance objectives related to the readings. Quizzes and job performance objectives had preset criteria for mastery by the teachers. The teacher instruction was conducted using the PSI, with repeated instruction or assistance until final mastery. Teachers proceeded at their own pace by accomplishing readings and quizzes outside of class; on-the-job mastery occurred during the teachers' assigned classroom periods. Examples of PSI modules are available from the second author.

Application to supervisors. The supervisors trained the teachers and assisted them in training teacher assistants on the job. The supervisors designed the teachers' modules and tutored and quizzed the teachers until they mastered their modules. Supervisors modeled correct performance with teachers and used the teacher performance rate/accuracy observation procedure to instruct teachers in accurate presentation of antecedent stimuli, accurate data collection, and accurate responding to the students' efforts.

The teacher observation procedure (Greer et al., 1989; Ingham & Greer, 1990) included direct assessment of teacher behavior and student behavior by a supervisor. These observations resulted in a record of each teacher's accuracy or inaccuracy of reinforcing, correcting, or ignoring student responses. The correct and incorrect responses of the student taught during the observation were tallied and converted to a rate measure. Each observation, showing both teacher and student responses, was presented in graphic form to the teachers along with spoken feedback concerning their performance and that of their students.

The supervisors maintained a log of their own accomplishments of administrative and supervisory tasks related to the following generic criteria (Greer et al., 1989). Each supervisory task had to result in a permanent product. Those tasks to be counted were those that resulted in changes in student or teacher behavior or had the potential to do so (e.g., involved interaction with teachers and students resulting in data collection) or resulted in child care (e.g., materials, equipment, scheduled services). Written products had set criteria (Greer, 1989). The categories of tasks included (a) monthly reports, (b) budgets, (c) interviews of individuals for employment, (d) phone calls and letters that resulted in products (e.g., materials, equipment), (e) parent and staff conferences with written minutes, (f) written quizzes for teachers, (g) teacher quizzes showing mastery, (h) written curricular programs for students, (i) teacher performance rate/accuracy observations, (j) memos to teachers or supervisors, (k) data points graphed, and (l) instructional sessions completed with students.

The supervisors also managed the data, ensuring

that the data were up-to-date. They also maintained summary graphs of all trials conducted, objectives achieved, and teacher performance rate/accuracy for each teacher. In addition, they saw to it that a weekly summary of school-wide data was maintained for review by the consultant.

Measurement

There were two categories of measurement: (a) measures of the reliability of implementation of the package and (b) the dependent variables. The implementation measures included supervisor tasks and quizzes and modules completed at mastery levels by teachers. These responses and their measurement are described under the description of CABAS. The dependent variables were students' total and correct trials by teacher group as well as objectives achieved. Examples of a trial and an objective are also presented under the description of CABAS.

Recording Protocol

For each trial or task analysis step, the teacher recorded the response on a form attached to the teacher's clipboard immediately after responding to the student's efforts. At the conclusion of the session, the teacher plotted the data point on the relevant graph for the student's program. The teachers and their assistants collected data in this manner throughout the day. They summarized all of the data for their classroom, which then were collected and checked for accuracy by the supervisor, who in turn plotted the data daily for the teacher (all students) and added the data to the total school performance for the day. At the end of the week, summaries of the performances of all instructional staff were plotted and posted.

Interobserver Agreement

Correct/total trials. The interobserver agreement indices for student total and correct trials were obtained from the teacher performance rate/accuracy observations conducted by supervisors. One component of this observation involved teacher and supervisor agreement on student responses. Supervisors rotated students and curricular programs observed in a systematic manner across all students in the teachers' classes. Supervisors also conducted observations of teacher assistants' accuracy using the procedure described. Weekly observations (with no feedback) were conducted of teachers during baseline, three times per week during the training phase (with teacher performance rate and accuracy feedback), and a minimum of once a week during full treatment (with teacher rate/accuracy feedback).

The teachers' agreement with supervisors involved a trial-by-trial assessment of agreements by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. The agreement means and ranges for correct and incorrect responses during baseline were 75% (60% to 80%) for Group 1, 73% (60% to 85%) for Group 2, 80% (60% to 85%) for Group 3, and 68% (55% to 80%) for Group 4. During the training phase (B1) and the full treatment phase (B2), the agreements for the four groups were 94% (78% to 100%) for Group 1, 99% (90% to 100%) for Group 2, 92% (88% to 97%) for Group 3, and 87% (80% to 90%) for Group 4.

Supervisor responses (implementation variable). The accuracy of the supervisors at recording their own tasks was checked six times during the study for each supervisor. These checks were done by a research assistant who compared supervisor checklists with products and monitored the time spent in school by supervisors. The agreement was 100% in all cases. These agreements are consistent with those reported by Babbitt (1986) in an unpublished analysis of supervisor responses at another school using CABAS.

Scorer agreement. The numerical calculations of student responses by teachers and supervisors were checked for accuracy by two individuals independently. The sums of students' correct and incorrect responses were calculated for 12 weeks of data randomly selected from all weeks of data. The scorer agreements were calculated by dividing the agreements plus disagreements of the first author and a research assistant into the number of agreements times 100%. The mean agreement was 99%. Disagreements were corrected to 100%.

Design

The design was a multiple baseline across teacher groups in which the number of teachers in each group varied. The grouping was necessitated by the school schedule, which required students to receive different curricula from different teachers. Thus, students received baseline conditions with some teachers while receiving the treatment package with other teachers.

The two phases of the treatment included a training phase (B1) and a full treatment phase (B2). The study involved 2 academic years. Data were collected for a 3rd year as a test of maintenance.

Baseline data consisted of 17 weeks for teachers in Group 1, 36 weeks for teachers in Groups 2 and 3, and 54 weeks for teachers in Group 4. The training phase (B1) included 4 weeks for Group 1, 4 weeks for the Group 2, 16 weeks for Group 3, and 5 weeks for Group 4. The full treatment phase (B2) included 50 weeks for Group 1, 31 weeks for Group 2, 19 weeks for Group 3, and 12 weeks for Group 4. Groups 2 and 3 began the training phase during the 1st week of the 2nd year. Previous applications indicated that fewer trials are conducted at the beginning of the year (Greer et al., 1989); thus, there was no reason to expect that the onset of a new year would inflate trials.

Procedure

Baseline. During baseline, the supervisors conducted weekly observations of teachers using the teacher performance rate/accuracy procedure. They did not give spoken or graphic feedback related to the teachers' performance rate or accuracy. Supervisor comments dealt with the accuracy of the teachers' recordings of data. Supervisors did not log their own tasks during this phase nor did they discuss or post teacher or student data.

The teachers conducted trials at their own initiation in baseline, using the teacher's own curriculum programs with the student. The law requires assessment of children receiving special education; thus, most special education teachers conduct some direct assessments of their pupils. The data taken by teachers were collected daily by the supervisors as they had been in previous years. Teachers received general in-service instruction (e.g., workshops on individual education programs) during baseline.

The students received instruction in all of the domains of the curriculum according to each student's individual education program (IEP). Teachers used praise typically and variably as a consequence for student correct responses, although the use of corrections varied with each teacher, as did the presentation of antecedent stimuli. Most teachers did not collect data on all of their instructional efforts.

Training phase (B). During the training phase, the supervisors worked with the teachers and students in their classrooms. The existing curricular programs were replaced with scripted curricula that also met the existing IEPs and baseline assessments. The supervisors taught the teachers to run the programs through modeling and by using the teacher performance rate/accuracy procedure to provide the teachers with rate/accuracy feedback on their own performance. Supervisors conducted at least three of these observations weekly. The supervisors instructed teachers to plot the children's data and keep the graphs up-to-date. Supervisors also gave teachers their first modules with reading and performance assignments. This phase continued until the teachers (a) could conduct one reliable data-based program for a single IEP goal per child, (b) had graphs and programs for all children's objectives, and (c) achieved mastery on the first quiz in her assigned module. In some cases, the teachers required tutoring and one or more attempts to pass the quiz, as is characteristic of PSI instruction. These efforts were coordinated across teacher groups to meet the requirements of the multiple baseline design. Supervisors logged their own tasks and converted their data to rate (per hour).

Full treatment phase. Once the teacher had passed one quiz and all components of the CABAS program were in place (see training phase), the full treatment phase was initiated. This meant that all children were receiving scripted curricula, and all daily performances were graphed and up-to-date for all programs for all children for whom the

teacher was responsible. The supervisor reduced the observations to a minimum of once weekly and met weekly with the teachers to review their classroom performance and to quiz and tutor the teachers on subject matter in the teachers' modules. The teachers' total classroom performance graphs (correct and total trials and objectives for all children in the class) were posted prominently in the school. When the teacher completed a set of 10 modules, she was awarded a $1,000 bonus, given congratulatory letters from the administration, and assigned a new set of 10 modules.

RESULTS

Teachers

The 3 teachers in Group 1 completed a mean of 9.33 modules (range 8 to 11) and 33 quizzes, and 1 teacher received the $1,000 bonus and completed a single module in her second set of 10 modules. During the maintenance year, the remaining teachers in Group 1 attained the bonus. The teacher in Group 2 completed three modules and eight quizzes. The 2 teachers in Group 3 each completed one module and five quizzes. The 2 teachers in Group 4 each completed three modules and nine quizzes. The teachers in Groups 2, 3, and 4 completed the criterion number of modules and received bonuses during the year following the study.

Supervisors

The data on supervisors provide an index of the reliability of treatment implementation. During the 1st year, when only Group 1 was in treatment (for approximately half of the year), the 2 supervisors performed a total of 4,855 tasks and the combined mean weekly tasks was 231, ranging from 82 to 500. The combined mean rate for the supervisors was 5.31 per hour (range, 1.8 to 8.2). During the 2nd year, as all teacher groups were entered into treatment, the 3 supervisors performed a total of 11,279 tasks with a combined weekly mean of 313 (range, 69 to 361). The combined mean rate was 9.3 (range, 1.8 to 11.48). There was no increase in hours spent at work.

Students

Trial data. The daily mean correct and mean total trials per week for students in Groups 1, 2, 3, and 4 are shown in Figure 1. The data shown are the daily means for weeks (a minimum of 3 days constituted a week), and the sessions are the weeks in the 2 academic years (Weeks 1 to 36 and 36 to 71). The daily means for each week were computed by dividing the number of days per week into the total for the week.

During baseline, the weekly means for correct and total trials were low and stable for Groups 1, 2, and 3. Group 2 showed an increase at the onset of Year 2 but stabilized prior to the intervention. During the training phase, total and correct responses increased over the baseline phase with some overlap between baseline and training phases for Groups 1 and 2. Overlap occurred between the full implementation and baseline in the following instances only: Week 36 (total trials only) for Group 1, Weeks 50 and 68 for Group 2, Week 50 (total trials) and Weeks 69, 70 and 71 (correct trials). For Group 4, there was no overlap between training and baseline or training and full implementation.

The percentage of correct responses for Groups 1, 3, and 4 differed little between baseline and treatment phases. They were: Group 1: baseline 68%, training 60%, and full treatment 67%; Group 3: baseline 51%, training 61%, and full treatment 57% Group 4: baseline 65%, training 74%, and full treatment 74%. Group 2 showed a mild decrease, averaging 78% for the baseline and 68% and 60%, respectively, for the training and full implementation.

Objectives achieved. The number of objectives achieved in teacher groups by baseline, training, and full treatment phases are shown in Table 1. During baseline the criteria for achieving objectives were set by each teacher, whereas during the training and full treatment phases the criteria were standardized per the scripted curriculum. Groups 1, 2, and 4 showed substantial increases in mean number of objectives achieved in full treatment phases over the baseline phases, whereas Group 3 showed little change.

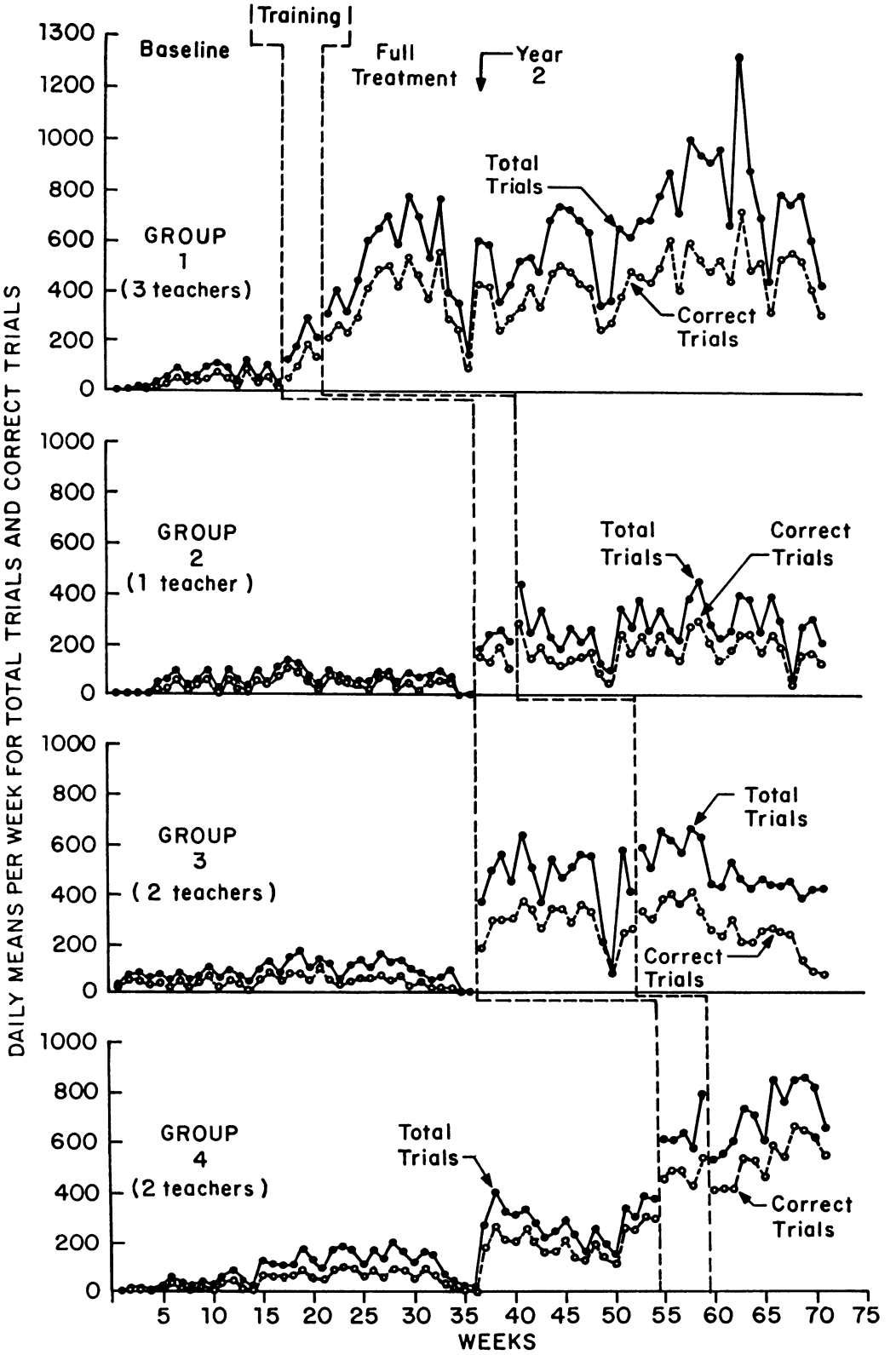

Figure 1. Daily means (per week) for total trials taught and correct trials for students of Teacher Groups 1, 2, 3 and for baseline, training, and full treatment phases across a 2-year period.

Maintenance. During the year following the full implementation of CABAS, the weekly means for total and correct trials, as well as objectives achieved, met or exceeded the means for all classrooms during the full implementation phase. These data are available from the second author.

DISCUSSION

The 2-year experiment and follow-up data showed that increases in trials taught, correct responses, and objectives achieved were a function of the implementation of the treatment package and that the effects were maintained. The results are consistent with prior correlational analyses of CABAS (Greer et al., 1989) and with analyses of the components of the package (Ingham & Greer, 1990). Moreover, the results replicate related findings in supervisory procedures used with staff in other types of institutions (Ayllon & Michael, 1959; Iwata et al., 1976; Parsons, Schepis, Reed, McCain, & Green, 1987), the literature on public posting and feedback (Burg, Reed, & Lattimore, 1979; Ivancic, Reed, Iwata, Faw, & Page, 1981), and on-the-job training (Burgio, Whitman, & Reed, 1983). The data also showed that the supervisory model (similar to CABAS) proposed by Reid and Shoemaker (1984) is viable. The results are consistent with correlational research in education concerning characteristics of effective schools (Cotton & Savard, 1980; Edmonds, 1979; Stallings, 1980).

There were some limitations to the study. For example, the students' correct responses appeared to be closer to total trials during baseline than during treatment (Figure 1). However, an analysis of the percentage correct shows little change, with the exception of Group 2, which declined slightly. This decline was apparently a function of not moving students to new objectives as old ones were learned during baseline. The accuracy maintenance in three groups suggests that greater teacher productivity did not lead to a detriment in quality (correct responses). However, why did the percentage correct not increase with growing expertise in behavior analysis? The lack of change may be a function of the nature of the CABAS program, which moves the student to a new objective (and a corresponding drop in percentage of correct responses) as soon as an objective is achieved. In fact, the increase in the number of objectives confirms this interpretation.

Table 1
Summary of IEP Objectives Obtained by Teacher Groups 1, 2, 3, and 4 During the Baseline, Training, and Full Treatment Phases

	Number of objectives met per phase	Phase mean per week of objectives achieved
Teacher Group 1		
Baseline	43	2.47
Training	10	2.50
Full treatment	573	11.46
Teacher Group 2		
Baseline	41	1.13
Training	11	2.75
Full treatment	73	2.35
Teacher Group 3		
Baseline	153	4.25
Training	85	5.31
Full treatment	83	4.36
Teacher Group 4		
Baseline	180	3.33
Training	31	6.20
Full treatment	109	9.08

Two groups of teachers were introduced to the training phase at the onset of Year 2 and showed an immediate increase in the dependent variable. Simultaneously, Group 4, which was still in baseline, showed an increase in the dependent variable. However, Group 4 showed an even higher increase over the baseline phase when the training phase was finally implemented. The baseline increase for Group 4 may have been a function of the fact that all classroom data were posted for all groups except their group. However, the subsequent application of the independent variable affirmed the controlling function of the total package.

An assessment of the teachers' reaction to the CABAS program was conducted by comparing teacher and teacher assistant turnover in employment for 2 years prior to the study, the 2 years of the study, and 1 year following the study. No

differences in turnover were found across the 5 years, suggesting that implementation of CABAS did not affect turnover.

Although there was a clear functional relationship between implementation of the treatment and the dependent variables, there are probably some components that are not essential. Some that prior research has shown to be important include the number and type of teacher observations (Greer, in press; Ingham & Greer, 1990), the number of response opportunities (trials) presented (Greenwood et al., 1984), and the number of supervisory tasks completed (Greer et al., 1989). It is not known how essential the completion of quizzes by teachers or the administrative tasks completed by the supervisors are; but both are necessary, either for administrative support or for ease of communication. The role of the bonus in changing teacher behavior is not clear, although the setting of teacher performance criteria has been shown to change teacher behavior (Dorow, McCorkle, & Greer, 1990). Although only 1 teacher (Group 1) achieved the bonus in this study, the remainder of the teachers did so in the subsequent year. Each module required substantial work to achieve mastery on the readings and classroom performance. The effectiveness of the bonus might have been enhanced if the modules had required less difficult objectives. In short, the relative contributions of many components of CABAS remain to be tested, including the level of sophistication in behavior analysis held by the supervisor and the consultant.

The rate of tasks emitted by supervisors increased dramatically. However, the actual work time did not. Thus, productivity involving direct teacher supervision increased, and the necessary administrative tasks were completed. The package does require intensive classroom supervision.

Despite these questions, the package has shown educationally significant effects on critical variables of schooling. CABAS is now being implemented at various stages in five schools for children with disabilities in this country and in one school in Italy for 1 year. The schools using CABAS represent student ability levels ranging from severe disabilities to those with mild developmental delays.

The package has not been tested in schools for nonhandicapped children or in public schools. Thus, effects of CABAS on these types of schools are unknown. However, the data warrant such a test. The need for more effective schooling procedures is generally recognized (Skinner, 1984). In summary, the comprehensive application of behavior analysis leads to more effective schooling practices in schools for children with disabilities or handicaps. Perhaps it will be effective in other schools as well.

REFERENCES

Ayllon, T., & Michael, J. (1959). The psychiatric nurse as a behavioral engineer. *Journal of the Experimental Analysis of Behavior,* **2,** 323–334.

Babbitt, R. (1986). Computerized data management and the time distribution and rate of tasks performed by supervisors in a data-based educational organization (Doctoral dissertation, Columbia University, 1986). *Dissertation Abstracts International,* **47,** 3737A.

Brophy, J. E. (1983). If only it were true: A response to Greer. *Educational Researcher,* **12,** 10–12.

Burg, M. M., Reid, D. H., & Lattimore, J. (1979). Use of a self-recording and supervision program to change institutional staff behavior. *Journal of Applied Behavior Analysis,* **12,** 363–376.

Burgio, L. D., Whitman, T. L., & Reid, D. H. (1983). A participative management approach for improving direct-care staff performance in an institutional setting. *Journal of Applied Behavior Analysis,* **16,** 37–53.

Cotton, K., & Savard, W. G. (1980). *The principal as instructional leader.* Portland, OR: Northwest Regional Educational Laboratory.

Dorow, L. G., McCorkle, N. P., & Greer, R. D. (1990). *Functional relationships between teacher performance and performance criteria.* Manuscript submitted for publication.

Edmonds, R. (1979). Effective schools for the poor. *Educational Leadership,* **37,** 15–27.

Engelmann, S., & Carnine, D. (1982). *Theory of instruction: Principles and applications.* New York: Irvington.

Greenwood, C. R., Delquadri, J., & Hall, R. V. (1984). Opportunity to respond and student academic performance. In W. L. Heward, T. E. Heron, J. Trap-Porter, & D. S. Hill (Eds.), *Focus upon behavior analysis in education* (pp. 58–88). Columbus, OH: Charles Merrill.

Greer, R. D. (1980). *Design for music learning.* New York: Teachers College Press.

Greer, R. D. (1983). The contingencies of a science and technology of instruction and opposition from prebehavioristic researchers. *Educational Researcher,* **12,** 3–10.

Greer, R. D. (1989). A pedagogy for survival. In A. Brownstein (Ed.), *Progress in the behavioral sciences* (pp. 45–80). Hillsdale, NJ: Erlbaum.

Greer, R. D. (in press). The teacher as strategic scientist: A solution to the educational crisis? *Behavior and Social Issues.*

Greer, R. D., McCorkle, N., & Williams, G. (1989). A sustained analysis of the behaviors of schooling. *Behavioral Residential Treatment,* **4,** 113–141.

Ingham, M., & Greer, R. D. (1990). *Functional relationships between supervisor, teacher, and student behavior.* Manuscript submitted for publication.

Ivancic, M. T., Reid, D. H., Iwata, B. A., Faw, G. D., & Page, T. J. (1981). Evaluating a supervision program for developing and maintaining therapeutic staff resident interactions during institutional care routines. *Journal of Applied Behavior Analysis,* **14,** 95–107.

Iwata, B. A., Bailey, J. S., Brown, K. M., Foshee, T. J., & Alpern, M. A. (1976). A performance-based lottery to improve residential care and training by institutional staff. *Journal of Applied Behavior Analysis,* **9,** 417–431.

Keller, F. S. (1968). Goodbye teacher . . . *Journal of Applied Behavior Analysis,* **1,** 79–89.

Kissel, R. C., Whitman, T. L., & Reid, D. H. (1983). An institutional staff training program and self-management program for developing multiple self-care skills in severely/profoundly retarded individuals. *Journal of Applied Behavior Analysis,* **16,** 395–416.

Lindsley, P. R. (1990). Precision teaching: By teachers for children. *Teaching Exceptional Children,* **22,** 10–15.

Parsons, M. B., Schepis, M. M., Reid, D. H., McCain, J. E., & Green, C. W. (1987). Expanding the impact of behavioral staff management: A large-scale, long-term application in schools serving severely handicapped students. *Journal of Applied Behavior Analysis,* **20,** 133–138.

Reid, D. H., & Shoemaker, J. (1984). Behavioral supervision: Methods of improving institutional staff performance. In W. P. Christian, G. T. Hannon, & T. J. Glahn (Eds.), *Programming effective human services: Strategies for institutional change and client transition* (pp. 39–61). New York: Plenum.

Robin, A. L. (1976). Behavioral instruction in the college classroom: A review. *Review of Educational Research,* **46,** 313–354.

Sherman, J. G., Ruskin, R. S., & Semb, G. B. (1982). *The personalized system of instruction: 48 seminal papers.* Lawrence, KS: TRI.

Skinner, B. F. (1968). *The technology of teaching.* New York: Appleton-Century-Crofts.

Skinner, B. F. (1984). The shame of American education. *American Psychologist,* **39,** 947–954.

Stallings, J. (1980). Allocated academic learning time revisited, or beyond time on-task. *Educational Researcher,* **9,** 11–16.

Sulzer-Azaroff, B., Drabman, R. M., Greer, R. D., Hall, R. V., Iwata, B. A., & O'Leary, S. (1988). *Behavior analysis in education 1968–1987 from the Journal of Applied Behavior Analysis.* Lawrence, KS: Journal of Applied Behavior Analysis.

Sulzer-Azaroff, B., & Mayer, G. R. (1986). *Achieving educational excellence with behavioral strategies.* New York: Holt, Rinehart & Winston.

Received June 9, 1989
Initial editorial decision September 20, 1989
Revisions received November 28, 1989; May 5, 1990; September 13, 1990
Final acceptance October 24, 1990
Action Editor, Susan A. Fowler